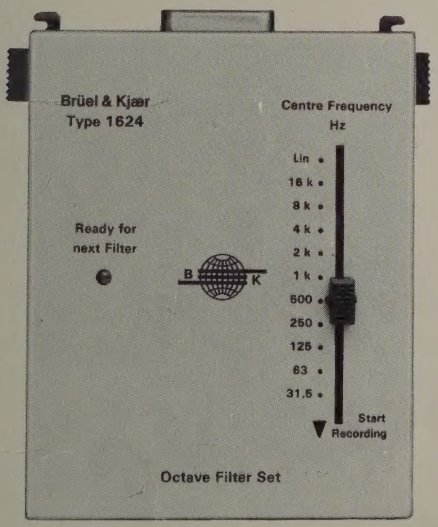
PROPERTY OF
Electro Rent
Corporation

1624

Instruction Manual

Octave Filter Set Type 1624



An Octave Filter Set primarily intended for use with Precision Integrating Sound Level Meter Type 2230 or 2233. Used with either of the Sound Level Meters, it forms a compact and portable lightweight unit enabling in situ octave acoustic analysis. Semi-automatic recording of the analysis is possible using either Level Recorder Type 2306 or Type 2309. Manual stepping of the filter is indicated by a green LED.

The selectable centre frequency range is from 31,5 Hz to 16 kHz and a linear position gives a frequency band from 5 Hz to 75 kHz. The analysed signal may also be weighted by selecting "A" or "C" frequency weightings on the Sound Level Meter.

Brüel & Kjær

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OCTAVE FILTER SET
TYPE 1624

From serial no.1032482

April 1983

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Octave Filter Set and Third Octave/Octave Filter Set

USES:

Filter Sets for Sound Level Meters Types 2230 and 2233

- Semi-automatic octave noise analysis (Type 1624)
- Automatic 1/3 octave and octave (with 1/1 or 1/3 oct. step) noise analysis (Type 1625)
- Attenuation of background noise
- Distortion measurements
- Loudness evaluation in accordance with ISO R 532 (Stevens and Zwicker)
- Noise checking to octave and third-octave limiting curves
- Building acoustic measurements
- Sound power measurements on machines

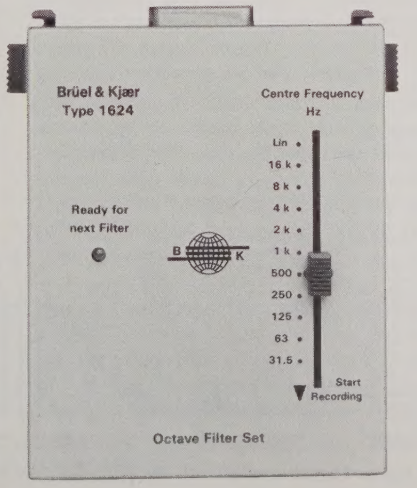
FEATURES 1624:

- 10 octave filters in accordance with IEC R 225-1966, DIN 45651 and ANSI S1.11-1966 Class II requirements; and unweighted linear response
- Centre frequencies from 31,5 Hz to 16 kHz, frequency range 22 Hz to 22 kHz (octave), 5 Hz to 75 kHz (Lin)
- 0 dB nominal filter attenuation

FEATURES 1625:

- 31 third-octave and 31 overlapping octave filters in accordance with IEC R 225-1966, DIN 45651, DIN 45652, and ANSI S1.11-1966 Class II & III requirements; and unweighted linear response
- Centre frequencies from 20 Hz to 20 kHz, frequency range 18 Hz to 22 kHz (1/3 oct.) and 14 Hz to 28 kHz (oct.), 3 Hz to 75 kHz (Lin)
- 0 dB nominal filter attenuation

Octave Filter Set Type 1624 and Third Octave/Octave Filter Set Type 1625 are primarily designed for use with the Precision Integrating Sound Level Meters Types 2230 and 2233 for in situ octave and 1/3 octave acoustic analyses. The Type 1624 enables octave analysis to be carried out, while Type 1625 offers 1/3 octave analysis and octave analysis in octave or 1/3 octave steps. Both filters are compatible with either of the Sound Level Meters, forming a complete, compact and portable, lightweight unit. Semi or fully automatic analysis recording is possible with a portable Level Recorder Type 2306 or 2309.



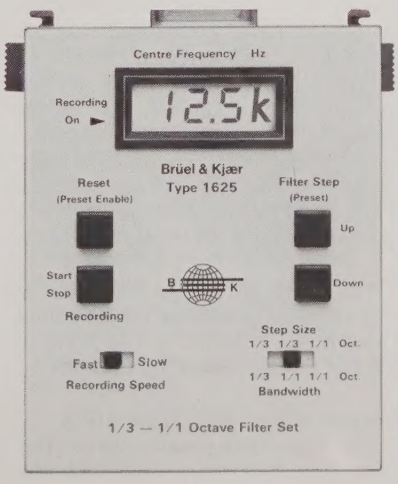


Fig. 1. Sound Level Meter Type 2230 with 1/3-1/1 Octave Filter Set Type 1625

The Octave Filter Set Type 1624 and the Third Octave/Octave Filter Set Type 1625 are both active filters, which are small in size and light weight. Both are easily fitted to the bottom of the Precision Integrating Sound Level Meter Type 2230 or 2233, ensuring both mechanical and electrical connections with proper matching of input and output impedances.

Adding a Filter Set to a Sound Level Meter greatly extends the uses of the instrument, enabling detailed frequency analysis to be carried out.

The overall frequency range of both filters sets covers the entire audio-frequency range with the centre frequencies arranged according to the preferred frequencies of ISO R 266, DIN 45401 and ANSI S 1.6-1960. The filters may be switched in successively manually (Type 1624 or 1625), or automatically (Type 1625). The level in each frequency band is displayed on the Sound Level Meter and may be noted in a measurement report or plotted on graph paper. For greater convenience the analysis can be recorded in situ, either semi-automatically (Type 1624) or automatically (Type 1625) using one of the portable B & K Level Recorders Type 2306 (one channel) or Type 2309 (two channels).

The signal fed to the Filter Set is also weighted as selected on the Sound Level Meter ("A", "C", "Lin. 20 Hz to 20 kHz" or "All Pass 10 Hz to 50 kHz").

Octave Filter Set Type 1624

The Type 1624 permits octave frequency analysis when used with the Sound Level Meter Type 2230 or 2233. The analysis can be recorded semi-automatically with the Level Recorder Type 2306 or 2309.

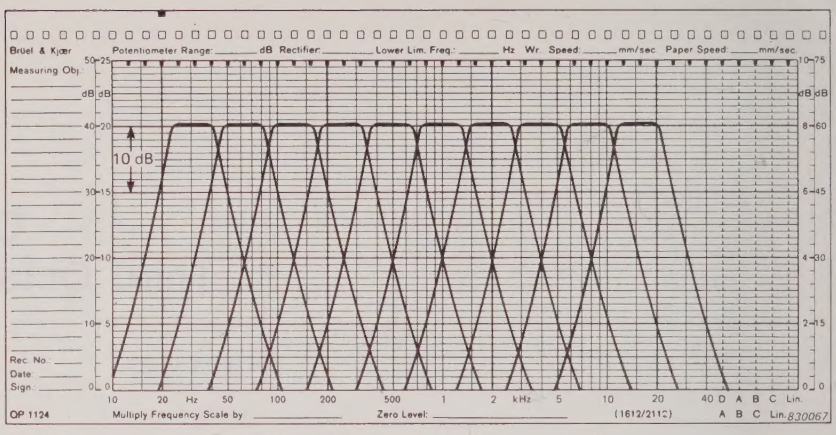

Brüel & Kjær
Potentiometer Range: ____ dB Rectifier: ____ Lower Lim. Freq.: ____ Hz Wr. Speed: ____ mm/sec. Paper Speed: ____ mm/sec.
Measuring Obj.
10 dB
Rec. No.
Date
Sign.
10 20 Hz 50 100 200 500 1 2 kHz 5 10 20 40
D A B C Lin.
QP 1124
Multiply Frequency Scale by
Zero Level:
(1612/2112)
A B C Lin.
830067

Fig. 3. Frequency characteristics of the 10 octave filters in Type 1624

The Type 1624 contains 10 active octave filters with centre frequencies from 31,5 Hz to 16 kHz. Each octave filter satisfies the requirements of IEC Recommendation R 225-1966, DIN 45651 and ANSI S1.11-1966 Class II, see Fig.2. The total frequency range is from 22 Hz to 22 kHz as can be seen in Fig.3. A linear position is also available covering the frequency range from 5 Hz to 75 kHz (–1 dB).

For semi-automatic recordings, the Filter Set is connected to the Level Recorder by the control cable AQ 0034 (or AQ 0182 for earlier Level Recorders). The ground connection is ensured by cable AO 0173 used to connect the Sound Level Meter to the Level Recorder. See Fig.4. The SPL for the selected frequency band is obtained from the Sound Level Meter Output, and the start/stop of paper movement is controlled by the Filter Set. The recording is made on graduated paper with a scale of 15 mm/octave, such as QP 0124 for Type 2306.

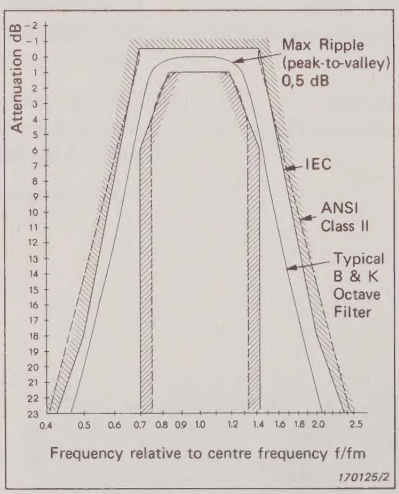

Attenuation dB
Max Ripple (peak-to-valley) 0,5 dB
IEC
ANSI Class II
Typical B & K Octave Filter
0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.4 1.6 1.8 2.0 2.5
Frequency relative to centre frequency f/fm
170125/2

Fig. 2. Top of an octave filter characteristic from the Filter Set Type 1624

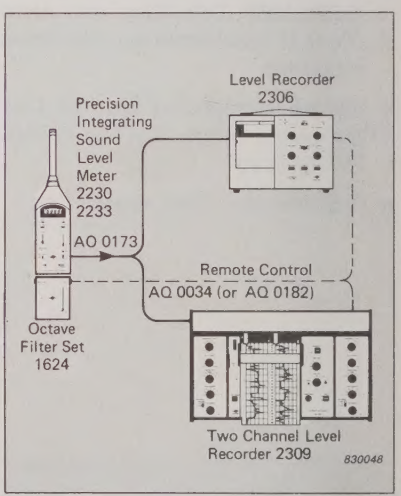


Fig. 4. Set-ups for semi-automatic octave analysis and recording with Type 2306 or 2309

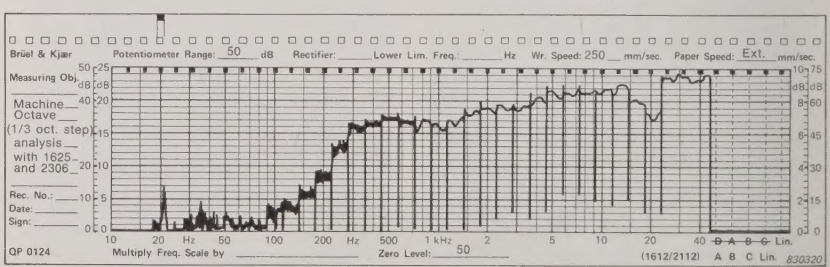

Brüel & Kjær
Potentiometer Range: 50 dB Rectifier: ____ Lower Lim. Freq.: ____ Hz Wr. Speed: 250 mm/sec. Paper Speed: Ext. mm/sec.
Measuring Obj.
Machine Octave (1/3 oct. step) analysis with 1625 and 2306
Rec. No.:
Date:
Sign:
10 20 Hz 50 100 200 Hz 500 1 kHz 2 5 10 20 40
D A B C Lin.
QP 0124
Multiply Freq. Scale by
Zero Level: 50
(1612/2112)
A B C Lin.
830320

Fig. 5. Octave analysis of machine noise using the set-up in Fig.4

When recording each octave, the filter output is disconnected from the Sound Level Meter during the first millimetre which corresponds to the settling time. Once the recording of one octave is completed, the paper stops and the indicator READY FOR NEXT FILTER lights up. At the end of the analysis the SPL with the linear weighting (or "A" or "C" if applied on the SLM) is recorded.

1/3 – 1/1 Octave Filter Set Type 1625

The Type 1625 permits 1/3 octave and octave frequency analysis. Octave frequency analysis can be made with octave or 1/3 octave step size. An unweighted frequency response (Lin) from 3 Hz to 75 kHz is also available.

The Type 1625 contains 31 active 1/3 octave filters and 31 overlapping 1/1 octave filters at 1/3 octave intervals covering 11 octaves. Centre frequencies are from 20 Hz to 20 kHz. Each filter fulfils the requirements of IEC recommendation 225-1966, DIN 45 652 and ANSI S1.11-1966 Class III for 1/3 octave filters; and DIN 45 651 and ANSI S1.11-1966 Class II for 1/1 octave filters, see Fig.6. The total frequency range is from 18 Hz to 22 kHz (1/3 oct.) and from 14 Hz to 28 kHz (1/1 oct.).

The level in each frequency band can be read on the Sound Level Meter's digital display, the centre frequency of the filter being displayed on the Filter Set. The filter centre frequency being selected manually by push button.

When the Filter is connected to a Level Recorder Type 2306 or 2309 the recording of the analysis and the filter stepping is carried out automatically. The Level Recorder is connected to the Sound Level Meter using cable AO 0173, and to the Filter Set using control cable AQ 0034 (or AQ 0182 for earlier Level Recorders). See Fig.7.

The filter scanning is electronically controlled and programmed to optimise the recording. The Filter Set increases the Level Recorder paper speed as the analysis band centre frequency is increased. Thus, an accurate recording is obtained in a minimum of time.

The starting frequency is selectable to eliminate low frequency components and the analysis can be interrupted and restarted during recording with the "Start/Stop" push button. An analysis can also be stopped before completion and the paper automatically moved to the next start position, ready for a new run.

Recording of octave analysis with 1/3 octave or 1/1 octave step size is also automatic. For octave analysis with octave step size, a choice between three series of centre frequencies is offered (lowest frequencies 20, 25 or 31,5 Hz).

Two analysis recording speeds ("Fast" or "Slow") are available to allow for stabilization of the Sound Level Meter detector depending on whether a "Fast" or "Slow" time weighting is selected on the Sound Level Meter.

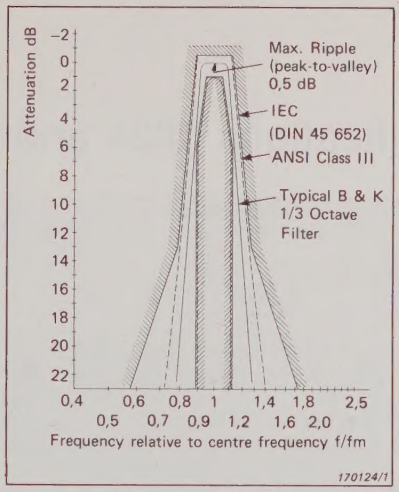


Fig. 6. Top of a 1/3 octave filter characteristic from the Filter Set Type 1625

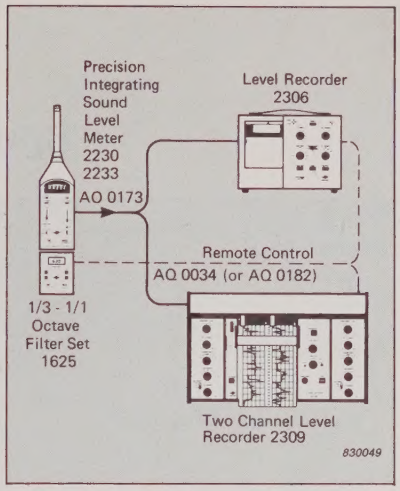

Precision Integrating Sound Level Meter 2230 2233
Level Recorder 2306
AO 0173
Remote Control
AQ 0034 (or AQ 0182)
1/3 - 1/1 Octave Filter Set 1625
Two Channel Level Recorder 2309
830049

Fig. 7. Automatic 1/3 octave analysis and recording with Type 2306 or 2309

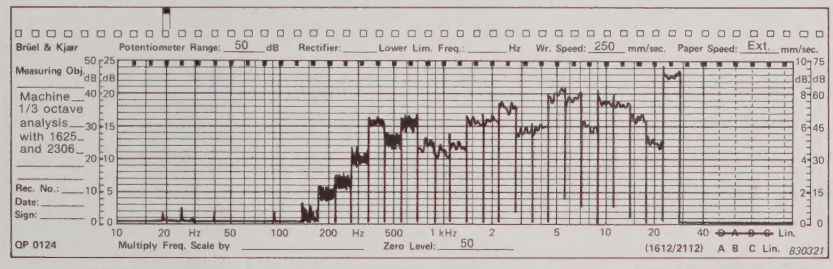


Fig. 8. Third-octave analysis of machine noise using the set-up in Fig.7

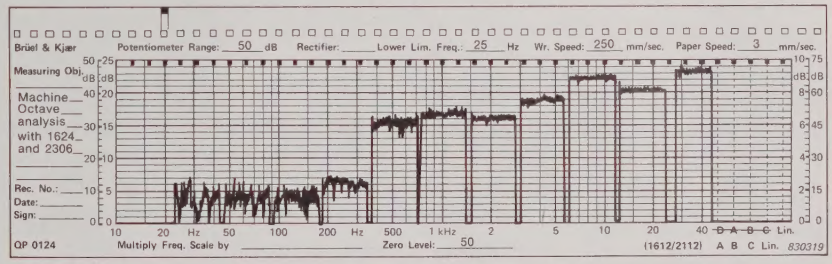


Fig. 9. Octave analysis with 1/3 oct. step size of machine noise using the set-up in Fig.7

Power supply

The active filters contained in the Filter Sets are powered from the Sound Level Meter through the 15 pin connector, provided the EXT. FILTER switch on the Sound Level Meter is set to "In". The battery pack in the Filter Set contains 4 cells IEC LR 6 (B&K No. QB 0013) and is always connected in parallel with the battery pack in the Sound Level Meter. The battery life (alkaline cells) of the Sound Level Meter/Filter Set is approximately 15 hours with the Type 1624 and approximately 8 hours with the Type 1625.

Specifications 1624 and 1625

Filter Set Type	1624 Octave	1625 Third-Octave and Octave
Frequency Range		
Selective	22 Hz to 22 kHz	18 Hz to 22 kHz (1/3 oct.), 14 Hz to 28 kHz (1/1 oct.)
Linear	Typical 5 Hz to 75 kHz (–1 dB)	Typical 3 Hz to 75 kHz (–1 dB)
Band-Pass Filters	10 active 6-pole Butterworth octave filters	31 active 6-pole Butterworth third-octave filters and 31 overlapping 1/1 oct. filters at 1/3 oct. intervals covering 11 octaves
In accordance with standard	IEC R 225–1966, DIN 45 651 and ANSI S 1.11-1966, Class II	IEC R 225–1966, DIN 45 652, DIN 45 651 and ANSI S1.11-1966, Class II & III
Centre Frequencies	31,5 Hz to 16 kHz	20 Hz to 20 kHz
Attenuation at Centre Frequency	0 dB ± 0,5 dB	0 dB ± 0,5 dB
Peak-to-valley Ripple	< 0,5 dB	< 0,5 dB
Attenuation outside Pass Band	See Fig.2 & 3, > 60 dB at 8 f_o and 1/8 f_o	See Fig.6, > 75 dB at 5 f_o and 1/5 f_o (1/3 oct.) > 60 dB at 8 f_o and 1/8 f_o (1/1 oct.)
Filter Shift	Slider switch Green lamp indicates time for filter switching when used with Level Recorder	Manual or Automatic with Level Recorder. 1/3 oct. or 1/1 Oct. steps for 1/1 oct. analysis
Remote Control	Semi automatic of Level Recorders Types 2306 and 2309 via cable AQ 0034 or AQ 0182	Automatic to/from Level Recorders Types 2306/09 via cable AQ 0034 or AQ 0182
Input Impedance	10 kΩ in series with 5 μF	10 kΩ in series with 15 μF
Input Terminating Impedance	≤ 100 Ω	≤ 100 Ω
Input Voltage	Max. 2 V sinus (2,8 V peak)	Max. 2 V sinus (2,8 V peak)
Output Impedance	< 5 Ω in series with 15 μF	< 5 Ω in series with 2,2 μF
Output Terminating Impedance	≥ 10 kΩ // 1 nF	≥ 10 kΩ // 1 nF
Inherent Noise	f_o Hz — max. μV 31,5 Hz — 200 (typ. 140) 63 Hz – 16 kHz — 150 (typ. 70) Lin — 250 (typ. 120)	f_o Hz (oct. or 1/3 oct.) — max. μV 20 Hz–40 kHz — 250 (typ. 170) 50 Hz–10 kHz — 150 (typ. 80) 12,5 kHz–20 kHz — 200 (typ.110) Lin — 250 (typ. 120)
Magnetic Sensitivity (50 Hz)	Approximately 1 mV output for 100 A/m field strength	
Operating Temperature	–10 to + 50°C (+ 14 to +122°F)	
Storage Temperature	–20 to +50°C (–4 to +122°F) Batteries Removed	
Influence of Temperature on Attenuation	< 0,5 dB (–10 to +50°C)	
Influence of Humidity on Attenuation	< 0,5 dB for 0 to 90% relative humidity at ≤ 40°C without condensation	
Batteries	4 × 1,5 V IEC Type LR6 (QB 0013). Batteries used as extra supply for SLM	
Dimensions	Length 105 mm (4,1 in) – Width 85 mm (3,3 in) – Height 47 mm (1,8 in)	
Weight	450 g (1 lb) including batteries	
Accessories Included	4 Alkaline batteries — QB 0013 1 Plug — JP 0802	
Accessories Available	1,5 m control cable — AQ 0034 1,5 m control cable — AQ 0182	

2. CONTROLS

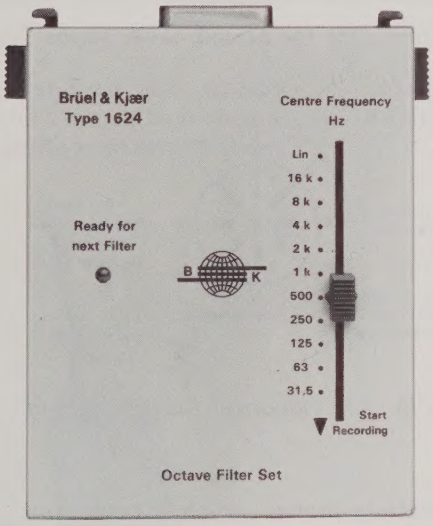


Fig. 2.1. Front view of the Filter Set

READY FOR NEXT FILTER: A green LED lit to indicate that the measurement at the selected frequency band has been completed and another frequency band may now be selected.
N.B. This facility functions only when the filter is synchronised for operation with Level Recorder Types 2306 and 2309.

CENTRE FREQUENCY: Slide switch with ten octave settings with centre frequencies from 31,5 Hz to 16 kHz and a setting for linear broad band response from 5 Hz to 75 kHz.

To begin a recording of an analysis at the lowest centre frequency when the Filter is synchronised with one of the above mentioned Level Recorders, the switch should be moved to the "Start Recording" position and released.

15 PIN CONNECTOR: 15 pin connector for use with the Sound Level Meters Type 2230 or 2233. This connector ensures signal connection, connection between the Sound Level Meter and Filter batteries, and power supply to the Filter Set when the Filter Set is included in the measurement circuit (i.e. EXT. FILTER "In" on the Sound Level Meter).

LOCKS: Two locks to ensure mechanical linking between the Filter Set and the Sound Level Meter.

RECORDER CONTROL: 8 pin DIN socket for synchronization of the Filter Set with Level Recorder Type 2306 or 2309.

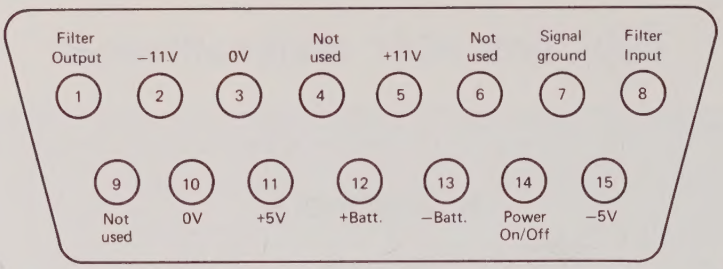


Fig. 2.2. 15 pin connector for Sound Level Meter Type 2230 or 2233

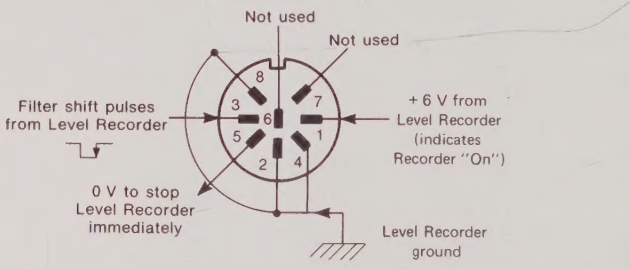


Fig. 2.3. Recorder Control socket

BATTERY DRAWER:

Battery drawer which accepts four 1,5 V alkaline cells (IEC type LR6, AA size). These are connected in parallel with the batteries in the Sound Level Meter (see section 3.2.).

Fig. 2.4. Side view of the Filter Set

3. OPERATION

3.1. PRELIMINARY

The Octave Filter Set Type 1624 employs only one active filter. The centre frequency can be varied in nine steps from 31,5 Hz to 16 kHz in accordance with national and international standards recommendations.

Fig. 3.1. Filter Set with the Sound Level Meter Type 2230

The Type 1624 is primarily designed for use with Sound Level Meters Type 2230 and 2233 to which it fits directly both mechanically and electrically. All electrical connections to the Sound Level Meter are made via the 15 pin connector.

To fit the Filter Set to the Sound Level Meter, remove the protective plastic plate at the bottom part of the Sound Level Meter. Press the two side locks on the Filter Set and engage the connector. Push gently until the 2 side locks are fastened, ensuring that the locks are again in their outer position. To insert the Filter Set in the measurement chain, set the EXT. FILTER switch on the Sound Level Meter to "In". The measured signal on the Sound Level Meter is now filtered in an octave band of centre frequency as indicated by the CENTER FREQUENCY selector. The signal is also weighted as selected on the Sound Level Meter, i.e. "A", "C" or "Lin". The SPL for the selected octave band is displayed on the Sound Level Meter. Semi-automatic recording of the frequency analysis can be obtained using Level Recorder Type 2306 or 2309 (See section 3.3).

3.2. POWER SUPPLY

3.2.1. Battery check

The Filter Set is powered via the Sound Level Meter to which it is connected. The batteries contained in the Filter Set are not used to power the Filter Set directly, but to increase the life of the Sound Level Meter power supply. Life time with alkaline batteries and Sound Level Meter Type 2230 or 2233 is approximately 15 hours.

To check the battery level of the Filter Set, connect the Filter Set to the Sound Level Meter, remove the battery drawer from the Sound Level Meter and check the display on the Sound Level Meter for "BAT" indication. If the "Bat" sign appears, approximately half an hour operation time is left, when using these batteries alone. If the "BAT" sign, and a non-resettable "↑" appear, the Filter batteries must be replaced.

N.B.: Only one set of batteries, either in the Sound Level Meter or in the Filter Set, is sufficient to power both instruments. Battery life is reduced to approximately 7 hours.

For long term storage, it is recommended that the batteries are removed in order to maintain their life and also as a general safety precaution.

3.2.2. Battery replacement

Unlock the battery drawer and pull it out. Remove the depleted batteries and place four new batteries with polarities as shown on the battery drawer. Push the drawer back into place until the lock is secured.

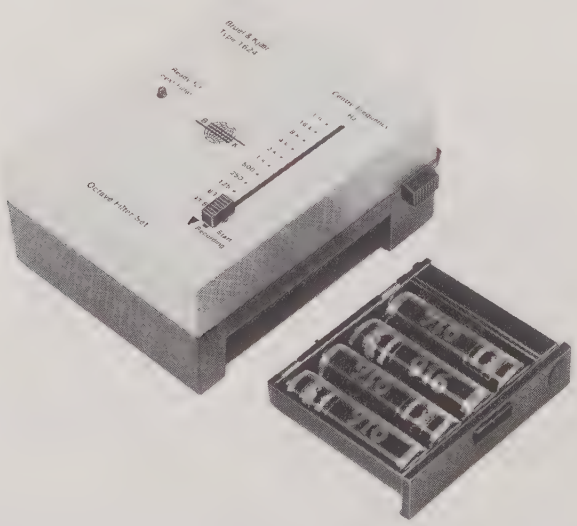


Fig. 3.2. Battery replacement

3.3 FREQUENCY ANALYSIS

3.3.1. Introduction

In this Instruction Manual the theoretical and mathematical aspect of the frequency analysis is not attempted. A comprehensive description of the frequency analysis theory will be found in the book "Application of B&K Equipment to Frequency Analysis" by R.B. Randall.

In the following paragraphs, the settings given for the Sound Level Meter apply to both the Types 2230 and 2233. When the settings for the two sound level meters are different, the setting for Type 2233 is given in brackets.

3.3.2. Frequency Analysis

The frequency selector is stepped manually to display, on the Sound Level Meter, the SPL in the various frequency bands. The green LED is inactive unless the Filter is connected to a Level Recorder.

Proceed as follows:

1. On the Sound Level Meter set:

DETECTOR:	"RMS"
TIME WEIGHTING:	"Fast" or "Slow"
DISPLAY:	"SPL" ("L_T" for 2033)
SOUND INCIDENCE:	As required
EXT. FILTER:	"In"
POWER:	"On"
OPERATING MODE:	"Operate"
FSD:	As required
RESET:	"All" or "Max./Min." ("Max." for 2033)
FREQ. WEIGHTING:	"All Pass" (The weighting selected is applied to the signal analysed)

2. Select the frequency band on the Filter Set, and read the corresponding level on the Sound Level Meter display.

To avoid tedious manual work and for more efficient use, Level Recorder Type 2306 or 2309 may be used for *in situ* semi-automatic analysis recording.

3.3.3. Frequency Analysis with Level Recorder

Semi-automatic recording of octave band frequency analysis is possible using Level Recorder Type 2306 or 2309. Recording of the frequency analysis provides a hard-copy result which is very convenient for documentation in reports.

Fig. 3.3. Level Recorder Type 2306

The synchronization of filter stepping and paper advance is achieved using control cable AQ 0034 (or AQ 0182 for earlier Level Recorders), while the level for each octave band is transmitted by cable AO 0173 connected to the Sound Level Meter (see Fig.3.4).

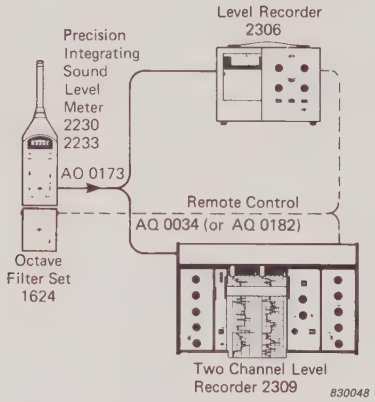


Fig. 3.4. Set-ups for semi-automatic octave analysis and recording with Type 2306 or 2309

The Type 1624 is equipped with a green LED which is lit when analysis in one octave band is completed and the centre frequency has to be stepped to the next centre frequency. Recordings may be made on a frequency preprinted paper (see Fig.3.5).

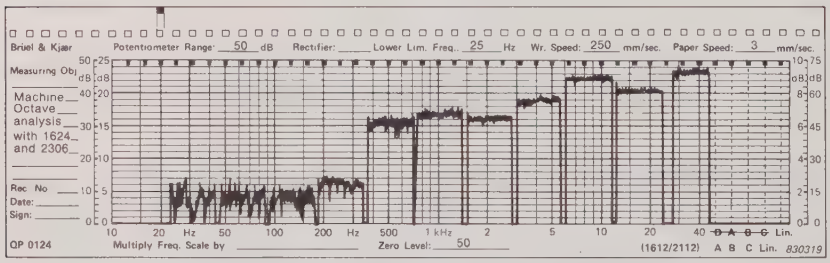


Fig. 3.5. Octave analysis on Type 2306

For octave band analysis recording with the Level Recorder Type 2306 proceed as follows:

Carry out preliminary checks on all three instruments (Sound Level Meter calibration, battery level, etc.). Load the Level Recorder with recording paper QP 0124 (QP 2100 for Type 2309), and make sure the PAPER DRIVE on the Level Recorder corresponds to 15 mm/octave (See Instruction Manual Type 2306). Connect the DC OUTPUT of the Sound Level Meter to the Level Recorder using cable AO 0173, and calibrate the Level Recorder for DC Lin. (See Instruction Manual for Type 2306). Plug in the Filter Set and connect the REMOTE CONTROL sockets of the Filter and Level Recorder using cable AQ 0034 (AQ 0182 for earlier models).

Note: For a proper control of the Level Recorder by the Filter Set, the ground connection for recording synchronization is ensured by the signal cable AO 0173 between the Sound Level Meter and the Level Recorder.

Set the controls on the Sound Level Meter as follows:

DETECTOR:	"RMS"
TIME WEIGHTING:	"Fast" or "Slow"
DISPLAY:	"SPL" ("L_T" for 2033)
SOUND INCIDENCE:	As required
EXT. FILTER:	"In"
POWER:	"On"
OPERATING MODE:	"Operate"
FSD:	As required
RESET:	"All" or "Max./Min." ("Max." for 2033)
FREQ. WEIGHTING:	"All Pass" (The weighting selected is applied to the signal analysed)

Set the controls on the Filter Set as follows:

WRITING SPEED:	"250 mm/s" or as required
PAPER SPEED:	"1mm/s" or as required
POWER:	In
PAPER DRIVE:	In
PEN DRIVE:	In
POLARITY SELECTOR:	"+"

On the Filter Set slide the CENTRE FREQUENCY selector to "Start Recording ▼" or to another centre frequency. When the paper stops, switch PAPER DRIVE "Off" and move the paper so the pen lies 7,5 mm before the starting centre frequency printed on the recording paper. Depress PAPER DRIVE.

To start recording slide the CENTRE FREQUENCY selector to "Start Recording ▼" for a frequency analysis from 31,5 Hz, or to the centre frequency chosen to start the analysis.

The recording of an octave has a length of 15 mm. During the first millimeter, which corresponds to the settling time, the Sound Level Meter is disconnected from the Filter and a low level is recorded. During this same time, the green LED READY FOR NEXT FILTER is lit. The level in the octave band is then recorded over the last 14 milimeters and the green LED READY FOR NEXT FILTER is lit again. Slide the CENTRE FREQUENCY selector to record the next octave until the frequency analysis is completed. After the highest octave is recorded, slide the CENTRE FREQUENCY selector to "Lin" to obtain the "All-Pass" recording

To record the "A" or "C" frequency response when the frequency analysis recording is completed, set FREQ. WEIGHTING to "A" or "C" and EXT. FILTER to "Out" on the Sound Level Meter. Slide the CENTER FREQUENCY selector to the next filter or to "Lin" or to "Start recording", and the "A" or "C" frequency response will be recorded.

The procedure for use with Level Recorder Type 2309 is similar to that for the Type 2306.

4. APPENDIX

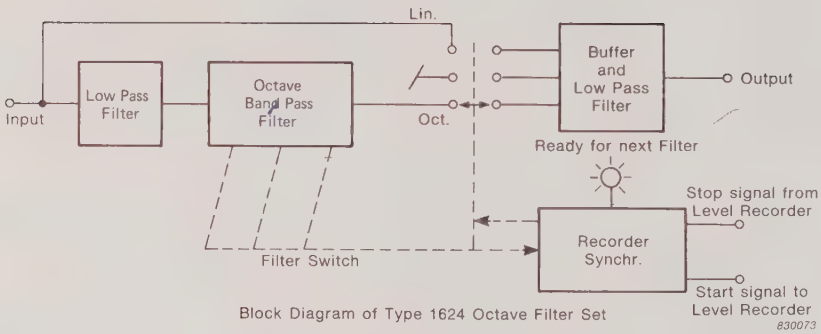
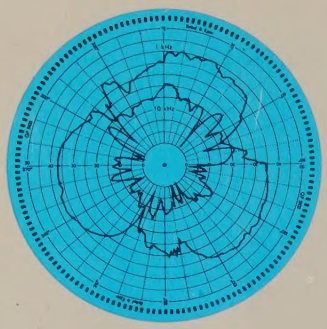
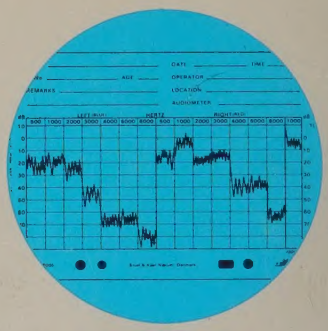


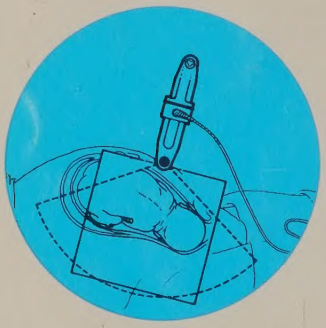
Fig. 4.1. Simplified block diagram of the Type 1624

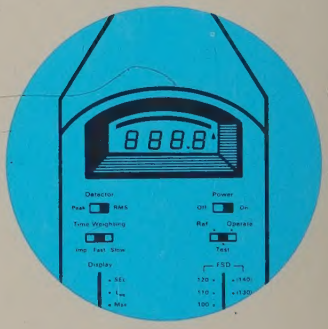
5. SERVICE AND REPAIR

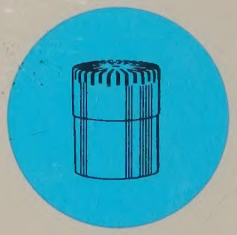
The Type 1624 is designed and constructed to provide the user with many years of reliable operation. However, should a fault occur which impairs its correct function, then its internal batteries should be removed to prevent risk of further damage. For repair consult the separate Service Instruction Manual available for the Type 1624 or contact your local B & K service representative. Under no circumstances should repair be attempted by persons not qualified in the service of electronic instrumentation.

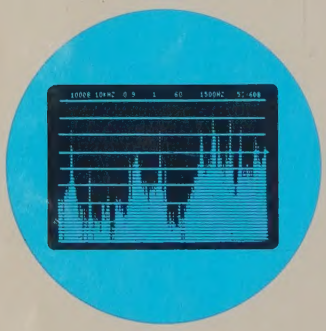


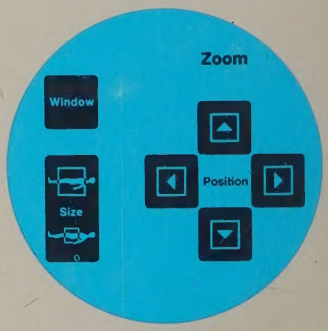


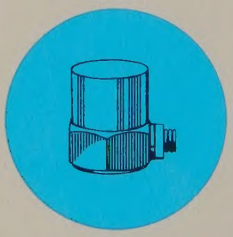


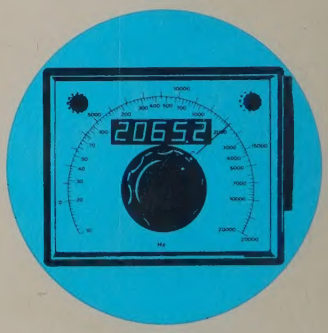


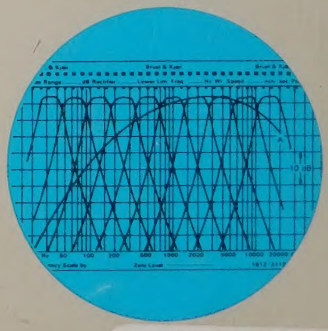












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